Evaluation of Impacts of the Belridge Geophysical Exploration Project on Small Mammal Burrows and the Endangered Plant, Kern Mallow (*Eremalche kernensis*) in the Lokern Natural Area, Kern County, California

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Monitoring Impacts of Seismic Operations on Small Mammal Use of Habitat in the Lokern Area, Kern County, California

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A survey of small mammal activity was conducted along cross-country seismic vehicle travel paths approximately 6 months after completion of a 3D vibroseis seismic project. The seismic project was conducted over approximately 28 Sections (17,900 acres) within the lokern area, Kern County, California. Preactivity surveys indicated the presence of many small mammal species including San Joaquin antelope squirrels (*Ammospermophilus nelsoni*) and several species of heteromyids, including giant kangaroo rats (*Dipodomys ingens*). Our survey was conducted to evaluate relative activity of small mammals within areas disturbed by seismic activity with that of control areas. We evaluated average number of active rodent burrows within travel paths used to lay 30 geophone lines (1760 ft/line). This number was compared to counts made along 30 control lines (1760 ft/line) that were parallel to the surveyed geophone lines, but 50 ft to the north or south. We recorded an average of 72.3 burrows/geophone line and 64.1 burrows/control line. It is possible that burrows in the travel paths were more visible due to crushed vegetation and this may have biased our counts. However, we also surveyed travel paths of vibroseis trucks (source lines) in the same area (n=50, 1320 ft/line), excluding vibroseis pad depressions, and found them to contain an average of 64.5 burrows each and 60.0 burrows/control line. Vibroseis pad depressions (n=850) that could be clearly delineated within the 50 source lines surveyed were found to contain 0.57 active burrows/pad depression. We converted number of small mammal burrows counted to number of burrows/1000 ft^2. Small mammal burrows along 30 travel paths used to lay geophone line averaged 5.3 burrows/1,000 ft^2 of transect. Control transects, that were sampled parallel to the geophone lines, averaged 4.7 burrows/1,000 ft^2 of transect. Along the 50 source lines small mammal burrows 4.9 burrows/ft^2 of transect. Small mammal burrows along the 50 control transects that were sampled parallel to the source lines averaged 4.4 burrows/1000 ft^2 of control transect. We observed an average of 27.1 burrows/1000 ft^2 within the boundaries of 850 vibe pad depressions along the source lines. Our data indicate no longterm impact on habitat use by burrowing rodents after approximately 6 months post-project completion of the seismic project. Moreover, it appears that relative loose soil along cross country travel paths created by seismic trucks used for geophone and source lines (excluding the bottom of the vibe pad depression) may have been especially attractive to burrowing rodents.

Part 1

Evaluation of the Impacts of 3D Seismic Exploration Activity in the Lokern Area, Kern County, California on Habitat Use by Small Burrowing Mammals.

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Introduction

We conducted a survey of small mammal activity and habitat use in October of 1994, approximately six months after a 3D seismic survey of the Belridge Geophysical Exploration Area in Kern County, California. Preactivity surveys indicated the presence of many small mammal species within the project area, including San Joaquin ground squirrels (*Ammospermophilus nelsoni*) and several species of heteromyid rodents including giant kangaroo rats (*Dipodomys ingens*). Other listed species include: Kern mallow (*Eremalche parryi* ssp. *kernensis*), San Joaquin kit fox (*Vulpes velox macrotis*), blunt-nosed lizard (*Gambelia sila*), and Hoover's wooly-star (*Eriastrum hooveri*). These species may be threatened by activities related to oil and gas development and the Bureau of Land Management, Bakersfield Office, issued a task order for evaluation of the impact of this project which lies within the Lokern Natural Area.

Species Account / Environmental Baseline

The project involves approximately 17,460 acres of private lands and 440 acres of land administered by the Bureau of Land Management (BLM) lands. The seismic prospect was conducted over an approximate 28 square-mile area (17,900 acres). The project area is comprised of 3,400 acres of active agricultural land (19%) and 14,500 acres (81%) of saltbush scrub vegetation. According to BioSystems (1991), approximately 25 percent of the Belridge survey project area (3,880 acres) is active farmland and 12 percent (1,850 acres) has been "heavily grazed." Grazing at varying degrees of intensity is thought to have occurred throughout much of the Lokern Road area (William Lehman, U.S. Fish and Wildlife Service, pers. comm. -in USFWS 1992). A more detailed account of habitat description, geophysical methods used, and effects of the project on sensitive wildlife and special status plant species is presented by BioEnvironmental Associates (1993) and by U.S. Fish and Wildlife Service (1993).

Methods

As part of mitigation required by USFWS (1993) BLM issued a task order for evaluating impacts of the geophysical operation on small mammal burrows and Ken Mallow (*Eremalche kernensis*). Specifically, **for small mammal burrows,** the task order

required:

Vibroseis Pads and Tires. Randomly select 50 source points (220 foot segment) to evaluate small mammal burrow collapse from the vibroseis truck pads and tires. Mark small mammal burrows within the segment with spray paint prior to vibroseis. Note the numbers within tire and pad imprints. Immediately following vibroseis, place pin flags or stakes to mark burrows for later observation. Between one and two weeks after vibroseis, resurvey the segment for all burrow activity (reopened, new, collapsed burrows). Resurvey again after three months.

Utility truck tires. Randomly select 30 travel segments (between source segments) and mark any small mammal burrows collapsed by utility truck tires. Resurvey the segments between one to two weeks after pickup truck travel, noting all burrow activity (collapsed, reopened, new burrows). Resurvey again after three months.

ATV tires. If burrow collapse from ATVs occurs, randomly select 30 travel segments (between source segments) and mark any small mammal burrows collapsed by ATV tires. Resurvey the segments between one to two weeks after ATV travel, noting all burrow activity (collapsed, reopened, new burrows). Resurvey again after three months.

We attempted to conduct an initial survey in the first week of March 1994, immediately after geophysical project activities were completed. At this time we could not locate any active burrows within the travel paths of vehicles used for the survey. For this reason we returned periodically until October, approximately 6 months later, when we were able to locate and count active burrows in these areas. We evaluated the average number of active rodent burrows within 30 travel paths, 1760 ft long by approximately 10 ft wide, used to lay geophone lines. Active burrows were defined as those having non-collapsed entrances and entrances free of wind blown litter, such as dried grass or leaves, and free of spider webs. The entrances of plugged burrows were evaluated for evidence of recent activity such as rodent tracks, and/or scrapings indicating active plugging of the burrow entrance.

Average number of burrows within the travel paths was compared to counts made along 30 lines, 1760 ft long by 10 ft wide, that were parallel to the surveyed geophone lines, but 50 ft to the north or south. We assessed the average number of burrows in 50 source lines, along which vibroseis trucks had traveled. These counts excluded burrows within vibe pad depressions. The lines were 1320 ft long by 10 ft wide. Along these lines we also counted the number of burrows within 477 vibe pad depressions (7 ft x 3 ft) that could be clearly delineated. Also, we assessed the average number of burrows along control transects that were parallel to the source lines, but 50 ft to the east or west.

The project area is roughly divided into northern and southern halves by Lokern Road. We counted approximately equal numbers of geophone, source and control lines on either side of Lokern Road.

Results

Figure 1 (W. J. Vanherweg - attached report) presents the project area and boundaries and the areas where Kern mallow was monitored. We monitored burrows and habitat use by small mammals in close proximity to those geophone and source lines presented in Figure 1. The BLM task order for the evaluation of Belridge Geophysical impacts on Kern Mallow (*Eremalche kernensis*) and small mammal burrows in the Lokern area is presented in Appendix A. Results of small mammal use of the seismic vehicle travel corridors are presented below and within Tables 1-4.

We attempted to mark small mammal burrows within the travel corridors during the geophysical project by spray painting burrows. The paint was removed by the various geophysical trucks as the tires broke up the soil surface and obliterated the paint. For this reason, we monitored burrow and habitat used by small mammal as described in the methods section (above). In addition, we could not document ATV impacts to burrows as ATVs used the same travel paths (geophone and source lines) most of the time.

We counted 2170 burrows for an average of 72.3 ± 25.0 burrows/line along 30 travel paths used to lay geophone line (Table 1). North of Lokern Road the average was 63.7 ± 26.7 burrows/line and South of Lokern Road the average was 80.9 ± 20.5. This is an average of 5.3 burrows/1,000 ft^2 of transect along these lines (Table 4).

Control transects, that were sampled parallel to the geophone lines, contained 1924 burrows in 30 lines for an average of 64.1 ± 28.6 burrows/line (Table 1). North of Lokern Road the average was 82.7 ± 21.8 burrows/line and south of the road the average was only 45.5 ± 21.8 burrows/line. This is an average of 4.7 burrows/1,000 ft^2 of transect (Table 4).

Along the 50 source lines we observed 3228 burrows for an average of 64.5 ± 32.3 burrows/line (Table 2). North of Lokern Road the average was 51.7 ± 25.9 burrows/line and south of the road there were 72.3 ± 33.7 burrows/line. This translates to 4.9 burrows/1,000 ft^2 of transect (Table 4).

The 50 control transects that were sampled parallel to the source lines contained 2898 burrows. There was an average of 60.0 ± 21.8 burrows/line (Table 2). North of Lokern Road the average was 56.7 ± 18.8 burrows/line and south of the road the average was 58.7 ± 23.7 burrows/line. This represents 4.4 burrows/1000 ft^2 of control transect (Table 4).

We observed an average of 0.57 ± 0.49 burrows within the boundaries of 850 vibe pad depressions along the source lines (Table 3). The average north of Lokern Road was 0.67 ± 0.71 burrows/pad and south of the road the average was 0.51 ± 0.25 burrows/pad. This translates to 27.1 burrows/1000 ft^2 of vibe pad depression area (Table 4).

Discussion

An apparent trend emerges from these data, though it cannot be statistically validated because of the variation in numbers of burrows among lines within groups. Control transects contained averages of 4.7 and 4.4 burrows/1,000 ft^2. Transects through which trucks were driven contained 4.9 and 5.3 burrows/1,000 ft^2. The most disturbed habitat, the vibe pad depressions, contained over five times as many burrows/ft^2.

It is possible that the travel of oil field vehicles made the counting of burrows easier within the travel paths as opposed to control areas in which vegetation was less disturbed. However, these surveys were conducted in October when grassy vegetation was dried and sparse. Additionally, most of the project area is subject to grazing, and observation of burrows in areas undisturbed by the activity of the Belridge 3D seismic survey activities was not difficult.

We believe that the data reflect an actual increase in the excavation of burrows by small mammals in the areas disturbed by seismic exploration activities. While some portions of the disturbed areas were compacted by truck travel, there were areas in which the soil was actually loosened. This is especially true for the vibe pad depressions. Though the floor of each pad depression contained relatively compacted soils, the margins of the pad depressions were delineated by raised berms of loose soil that the vibes pad had constructed. These berms were very much like a miniature version of roadside berms that are composed of loose soil deposited by road blading activities. It was our observation that a majority of the burrows counted in pad depressions were constructed in the loose soil in these marginal berms.

The effects of travel associated with the seismic operation was clearly visible months after the survey was completed, and at first glance would appear to be devastating to small mammals in the travel paths. However, the impacts associated with the activity appear to have had some positive effect on burrow construction by the small mammal community. Moreover, it appears that relative loose soil along cross country travel paths created by seismic trucks used for geophone and source lines (excluding the bottom of the vibe pad depression) may have been especially attractive to burrowing rodents. The floor of each vibe pad depressions contained relatively compacted soils, the margins of the vibe pad depression were delineated by raised berms of relative loose soil. These berms were very much like a miniature version of roadside berms that are composed of loose soil that is deposited by road blading activities.The benefit, or hazard, to small mammals constructing burrows within the disturbed areas remains to be fully understood and evaluated.

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U.S. Fish and Wildlife Service. 1993. Reinitation of Formal Section 7 Consultation Concerning Chevron Exploration and Production Services' Proposed Belridge 3D Seismic Survey in the Lokern Road Area, Kern County California. 23 pp. Reference number 1-1-92-F- 26(R1).

Table 1. A summary of numbers of small mammal burrows recorded along geophone travel paths in the Lokern Belridge 3D study area.

Geophone lines n=30	Total Burrows	Average	SD	Range
	2170	72.3	25.0	20-119
15 south of Lokern Road	956	63.7	26.7	20-107
15 north of Lokern Road	1214	80.9	20.5	54-119
Control lines n=30	1924	64.1	28.6	14-110
15 south of Lokern Road	683	45.5	21.8	14-92
15 north of Lokern Road	1241	82.7	21.8	47-110

Table 2. A summary of numbers of small mammal burrows recorded along source line travel paths in the Lokern Belridge 3D study area.

Source lines n=50	Total Burrows	Average	SD	Range
	3228	64.5	32.3	11-149
31 south of Lokern Road	2245	72.3	33.7	19-149
19 north of Lokern Road	983	51.7	25.9	11-94
Control lines n=50	2898	60.0	21.8	19-101
31 south of Lokern Road	1820	58.7	23.7	19-101
19 north of Lokern Road	1078	56.7	18.8	23-92

Table 3. A summary of numbers of small mammal burrows recorded within source line vibe pad depressions in the Lokern Belridge 3D study area.

Vibe pad depressions n=850	Total Burrows	Average	SD	Range
	447	0.57	0.49	4-49
597 south of Lokern Road	317	0.51	0.25	4-49
253 north of Lokern Road	130	0.67	0.71	6-32

Control lines (numbers of burrows from control lines along the source lines were used for comparison)

Source lines with vibe pad depressions n=50	Total Burrows	Average	Range
	447	8.94	0-34
597 south of Lokern Road	317	10.23	0-34
253 north of Lokern Road	130	6.84	1-19

Table 4. Comparisons of small mammal burrows along seismic travel corridors when standardized within a 1000 ft^2 corridor

Geophone lines n=30

2170 burrows total = average = 72.3 ± 25.0 burrows/line
North of Lokern Road = average = 63.7 ± 26.7 burrows/line
South of Lokern Road = average = 80.9 ± 20.5 burrows/line

This is an average of 5.3 burrows/1000 sq ft of transect along these lines

Geophone Control lines n=30

1924 burrows = average = 64.1 ± 28.6 burrows/line
North of Lokern Road = average = 82.7 ± 21.8 burrows/line
South of Lokern Road = average = 45.5 ± 21.8 burrows/line

This is an average of 4.7 burrows/1000 sq ft of transect along these lines

Source lines n=50

3228 burrows total = average = 64.5 ± 32.3 burrows/line
North of Lokern Road = average = 51.7 ± 25.9 burrows/line
South of Lokern Road = average = 72.3 ± 33.7 burrows/line

This is an average of 4.9 burrows/1000 sq ft of transect along these lines

Source Control lines n=50

2898 burrows total = average = 60.0 ± 21.8 burrows/line
North of Lokern Road = average = 56.7 ± 18.8 burrows/line
South of Lokern Road = average = 58.7 ± 23.7 burrows/line

This is an average of 4.4 burrows/1000 sq ft of transect along these lines

Vibe Pad Depressions n=850

447 burrows total = average = 0.57 ± 0.49 burrows/pad
North of Lokern Road = average = 0.67 ± 0.71 burrows/pad
South of Lokern Road = average = 0.51 ± 0.25 burrows/pad

This is an average of 27.1 burrows/1000 sq ft of transect along these pads

Part 2

Evaluation of Impacts of the Belridge Geophysical Exploration Project on the Endangered Plant, Kern Mallow (*Eremalche kernensis*)

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INTRODUCTION

The endangered Kern mallow is a small annual herb of the mallow family, 2 to 20 inches in height (BioSystems 1991), with white to rose-pink or lavender flowers that may be either perfect or male-sterile. Kern mallow occurs at mid-elevations on eroded hillsides and flats in the Lokern area. It has been reported in the Temblor Mountains and Carrizo Plain in Kern and San Luis Obispo Counties, however, Taylor (pers. comm.) determined these specimens to be male-sterile *Eremalche parryi*. The Lokern area is dominated by the valley saltbush scrub plant community with *Atriplex spinifera* being the most prominent shrub.

The species is threatened by oil and gas development, transmission line maintenance or expansion, ag-land conversion, overgrazing by livestock, exotic plant competition, and off-road vehicle use. A recovery plan has not yet been developed for Kern mallow.

Taylor and Davilla (1986) relocated four of the six historically documented populations of Kern mallow in 1986. Of these four, three are located within the Belridge Geophysical Exploration Project area and are now considered one population; the fourth is just northeast of the project boundary near the California Aqueduct. While Bates' 1992 treatment of Kern mallow extends the geographical range of the subspecies westward out of the Lokern type locality into San Luis Obispo County, the importance of the Lokern populations, in which the Kern mallow "trademark" of predominately female plants with white corollas is most strongly expressed, remains undiminished.

METHODS

The Bureau of Land Management Task Order for this evaluation called for the following methodology:

Vibroseis Pads. Randomly select 50 source points (220 foot segment) within the identified high concentration areas to evaluate kern mallow numbers and growth characteristic effects from the vibroseis truck pads. During the 1994 kern mallow flowering season, establish 10 one meter by one meter paired plots within each segment. One plot will be within the vibroseis pad imprint, and one will be adjacent on undisturbed soil. Sample plant numbers, number of flowering heads or fruiting

bodies, and plant height. Also estimate total plant cover.

Vibroseis truck tires. Randomly select 30 travel segments in the identified high concentration kern mallow areas (between source segments) impacted by vibroseis truck tires. During the 1994 kern mallOw flowering season, establish 10 0.1 meter by 1 meterpaired plots within each segment One plot will be within the vibroseis truck tire imprint, and one plot will be adjacent on undisturbed soil. Sample plant numbers number of flowering heads or fruiting bodies, and plant height. Also estimate total plant cover.

Utility truck tires. Randomly select 30 travel segments in the identified high concentration kern mallow areas (between source segments) impacted by Utility truck tires. During the 1994 kern mallow flowering season, establish 10 0.1 meter by 1 meter paired plots within each segment. One plot will be within the Utility truck tire imprint, and one plot will be adjacent on undisturbed soil. Sample plant numbers, number of flowering heads or fruiting bodies, and plant height. Also estimate total plant cover.

ATV tires. Randomly select 30 travel segments in the identified high concentration kernmallow areas (between source segments) impacted by ATV tires. During the 1994 kern mallow flowering season, establish 10 0.1 meter by 1 meter paired plots within eachsegment. One plot will be within the ATV tire imprint, and one plot will be adjacent on undisturbed soil. Sample plant numbers, number of flowering heads or fruiting bodies, and plant height. Also estimate total plant cover.

RESULTS

I started looking for kern mallow seedlings in February 1994. I found several seedlings at two sites on the north side of Lokern Road approximately 1.25 and 0.25 miles east of the Laidlaw Lokern Facility (Figure 1), in the drainage just south of the Laidlaw Facility and along the pipeline that runs parallel to Highway 33 in the southwest corner of the project area (Figure 1).

I monitored these sites through the month of March in order to determine the optimum time to begin my evaluation. The seedlings in the drainage and along the pipeline all dried up and died before flowering. Many never progressed beyond the two to three true leaf stage. Some of the plants east of the Lokern Facility flowered (one or two flowers per plant) and produced seed. I found approximately 35 plants growing along Geophone Line 1120 (one in a tire track) however, none of these specimens were contained in my randomly selected, paired survey plots. I found five plants along Source Line 1114-5120 one of which was in a vibe pad depression.

I surveyed over 50 source lines (with six source points each) and associated travel routes in March and April in and near high density Kern mallow areas (Figure 1). No other Kern mallow plants were found.

DISCUSSION

The failure of Kern mallow, in most of the study area, to flower and set seed was apparently do to lack of precipitation at critical times during seedling development. I did observe bands of sheep, sheep sign, and evidence of grazing on annual grasses and forbs through out the study area during the period of Kern mallow seedling development. The timing of this grazing could have contributed to the general lack of reproductive success of Kern mallow in the Lokern area during the 1994 growing season.

The lack of specimens of Kern mallow at and near all but one source line and one geophone line of the 50 segments surveyed made our attempts to evaluate project related impacts of the Belridge Geophysical Exploration Survey on Kern mallow impossible in 1994. We suggest the following revisions in methodology during the remaining four years of monitoring of Kern mallow in the project area:

Enlarge the paired study plots to include the entire disturbed area of 10 complete source lines (6 source points each) and an equivalent area in the undisturbed area adjacent to the source lines. The dimensions of each plot will be approximately 1320 feet long and 10 feet wide. The total number of source points sampled will be 60. We recommend the same number and dimensions for geophone line sampling. I have delineated suggested locations for the plots on Figure 1. The location of the Kern mallow plants within the plots with respect to vibe pad and tire track depressions should be noted along with the data suggested in the original protocol. This revised methodology will make it possible to collect useful data even during years when Kern mallow is sparse.

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APPENDIX A